

Response re: 09/813,839**Page 2 of 16****Amendments to the Specification:**

On page 1, please delete the following text which begins immediately after the title:

--Cross-references to related applications

none

Statement Regarding Federally sponsored R&D

Not applicable

Reference to Microfiche Appendix

Not applicable--

Please replace the paragraph beginning at page 3, first line with the following rewritten paragraph:

--One of the particular challenges in this arena is the need for very precise control of the distance between the focusing lens and the printing plate surface. To establish this control, the focusing lens is affixed to the moving member of an actuator. ~~In this application for letters patent this This~~ moving member ~~shall be~~ is referred to herein as a plunger. Data is written at very high speeds in these systems and the focusing lens has to maintain a precise "flying height" in this process. Because of the large lateral distances traversed in this application compared with typical data storage devices, the actuators have to maintain this accurate separation while the plunger of the actuator traverses over a considerable stroke length to allow the focusing lens to "follow" the variation of the printing plate or medium.--

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Please replace the paragraph beginning at page 4, ninth line with the following rewritten paragraph:

--In providing linear force control on the plunger of magnetic actuators, previous control techniques have included flux feedback, force feedback and current/gap feedback methods. In the case of electrostatic actuators there has as been comparatively little described in respect of means to control such actuators beyond simple two-state devices. This dearth of practical analog electrostatic actuator devices is related partly to the nature of the applications that employ them, but also in particular to the difficulty in controlling them in view of the non-linear actuation forces.--

On pages 8 and 9, please delete the following text, beginning on the fourteenth line of page 8:

--It is an objective of the present invention to obtain improved dynamic performance at high displacement speeds and frequencies from an actuator driven with a substantially non-linear force by linearizing the relationship between the actuating impetus and the feedback signal through the separate and concurrent control of dynamic and static characteristics of the actuator.

It is a further objective of the present invention to address the linearization of the relationship between actuating impetus and feedback signal in the particular case of actuators where space is at a premium and additional feedback sensors are difficult to accommodate.

It is yet a further objective of the present invention to address the linearization of the relationship between actuating impetus and feedback signal in a microelectromechanical actuator where additional feedback sensors are particularly difficult to implement and the

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non-linearity in the actuating force has particularly detrimental consequences.--

Please replace the paragraph beginning at page 12, second line with the following rewritten paragraph:

--The present invention will be described ~~at the hand of with reference to~~ a schematic diagram of a generic electrostatic microelectromechanical (MEMS) actuator and its control system as given in FIG.1, representing the preferred embodiment of the invention. With reference then to FIG.1, a cantilever electrode 1 and a second electrode 2 are fashioned on the cantilever 3 and base 4 of the MEMS device respectively. The actuating impetus 5 is in the form of voltage V, which is applied between these two electrodes and which causes the two electrodes to exhibit mutual electrostatic attraction. In this preferred embodiment, cantilever 3 represents the generic plunger and the electrostatic attractive force 6 represents the generic actuating force in the actuator device. Due to the fact that cantilever 3 is extremely thin, it can elastically deflect downwards towards the attractive second electrode 2. The range over which such a device deflects is referred to ~~herein in this application for letters patent~~ as the actuation range. In this preferred embodiment the vertical component of the elastic force on the cantilever 3 represents the generic restoring force 7. Since the actual angular deflections in MEMS devices are relatively small, this force may be taken as substantially linear with the deflection of the free edge of the cantilever 3.--

Please replace the paragraph beginning at page 16, sixth line with the following rewritten paragraph:

--To make an actuator to operate at high displacement rates, cognizance must be taken of the resonant frequency of the

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plunger, which, at a given displacement x is given by an equation of the form:

$$w = [k_s/m]^{1/2} \quad \dots (7)$$

where m is the mass of the generic plunger, represented in the preferred embodiment by cantilever 3 and where k_s is the instantaneous equivalent spring constant, not to be confused with the effective spring constant k_0 . We employ here the concept of instantaneous equivalent spring constant to describe the oscillatory behavior of the cantilever 3 for small amplitudes of vibration at a generalized displacement x under the action of an applied actuating force 6. When there is no actuating force applied and the plunger is in its rest position, this frequency is denoted by w_0 , which we refer to ~~herein in this application for letters patent~~ as the natural mechanical resonant frequency. The resonant frequency of the plunger at a general displacement under the influence of the actuating force, will be referred to ~~herein in this application for letters patent~~ as the forced resonant frequency.--

Please replace the paragraph beginning at page 17, eighteenth line with the following rewritten paragraph:

--In order to describe the dynamic behavior of the device, speed or momentum and acceleration need to be factored in. This, however, also advantageously provides a means to linearize the device. In the preferred embodiment of the present invention, the slope of the displacement with respect to applied voltage is dynamically kept constant over the actuation range by manipulating, at appropriately high speed, the only controllable variable at our disposal, namely the applied voltage itself. With reference to equation (8), this produces an instantaneous equivalent spring constant that is

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substantially constant over the actuation range. Along with it there results, by virtue of equation (7), a forced resonant frequency that is substantially constant over the same range. ~~In this application for letters patent the~~ The instantaneous slope of the applied voltage with respect to the displacement of the plunger is referred to herein as the actuation gradient and the resonant frequency that is imposed on the actuator by this approach, is referred to herein ~~in this application for letters patent~~ as the imposed resonant frequency.--

Please replace the paragraph beginning at page 20, seventeenth line with the following rewritten paragraph:

-- It is to be noted that, by intentionally restricting the actuation range to exclude the rest position and positions in proximity to it, a value of m may be selected and imposed on the system in such a way that the imposed resonant frequency is in fact greater than w_0 . This reduced actuation range is referred to herein ~~in this application for letters patent~~ as the fractional actuation range. In the general case this fractional actuation range can equate the full actuation range at which point the imposed resonant frequency that may be maintained will be w_0 .--

Please replace the paragraph beginning at page 24, tenth line with the following rewritten paragraph:

--It is to be noted that, while the execution of this method by means of software or firmware comprises sequential actions with respect to the two sets of lookup tables, these actions are performed every time the actuation cycle is undertaken. ~~In this application for letters patent we use the~~ The term concurrent is used herein to describe this temporal arrangement of the actions. In this preferred embodiment of

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the present invention the dynamic and static control actions are therefore performed concurrently, but separately, with respect to dynamic behavior on the one hand and static behavior on the other.--

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